FIG. 4. Schematic representation of *T. radiata* webs in *Pentaclethra macroloba*

PREDATOR SUCCESS IN GOLDEN ORB-SPIDERS (*NEPHILA CLAVIPES*)

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Abstract (AVB) The Golden Orb-spider is unusual among web weaving spiders because rather than being able to throw silk around its prey from a distance, it must directly attack and bite its prey. As this contact with the live prey poses a physical threat to the spider, spiders should be more cautious when dealing with prey closer to their body size. Less experienced spiders therefore might be more hesitant and less successful predators. We found that the larger, more experienced Golden orb-spiders reacted more quickly to prey, and hesitated less in their attack than smaller spiders. Spiders attacking proportionately smaller prey exhibited less lag time between reaction and attack. As spiders did not differ in either reaction time or lag time between live and dead prey, we believe detection of movement is the true mechanism by which spiders recognize the presence of their prey.

INTRODUCTION (SDK)

The Golden Orb-Spider, *Nephila clavipes*, is unusual among orb weaving spiders in its method of capturing prey. Rather than casting silk threads over insects caught in their webs, *N. clavipes* attacks its prey directly and subdues them with an aggressive, and possibly venomous, bite (Lubin 1983). Presumably, this need for direct physical contact poses some threat to the spider; live, entrapped prey may potentially sting, bite, or otherwise wound their attacker in a struggle.

We examined predator behavior in several *N. clavipes* individuals of different sizes. Successful predators should detect and attack prey quickly, without hesitancy, thus offering prey little opportunity to escape. We predicted that larger, more experienced spiders would be more successful predators, showing a faster reaction time and shorter lag time between prey detection and prey attack. Furthermore, we predicted that spiders of all sizes would be more aggressive towards proportionately smaller prey, showing less hesitancy in their initial attack. Finally, we hypothesized about the mechanism of prey detection by *N. clavipes*, expecting vibrations created by movement of prey to alert predators to their presence. Hence we predicted that spiders would react faster to live prey and be slower to detect dead prey in the web.

METHODS (AVB)

We located eight *N. clavipes* at the La Selva Biological Station. We performed four trials on each of these spiders, for a total of 32 trials. Each trial consisted of a grasshopper prey being thrown into the web approximately 10 cm from the spider. We recorded the time until the spider reacted to the prey, usually by lifting the web with her front legs to check for tension or by making a deliberate move towards the prey. We recorded the lag between the time the spider reacted and the time the spider attacked and bit the prey. The fate of the prey was recorded. If the spider had not attacked the prey after five minutes, we ended the trial.

Each spider received a small prey (grasshoppers 5 to 10 cm in length), a medium prey (grasshoppers 10 to 15 cm in length), a large prey (grasshoppers 15 to 25 cm in length) and a dead prey for a total of four trials per spider. Dead prey were killed by soaking the grasshoppers in alcohol. Spiders were fed dead grasshoppers of a size class in which they had consumed a live prey. Feeding was spread out over two days to avoid satiation.

RESULTS (AVB)

Larger spiders reacted faster to prey than smaller spiders (Spearman Rank Correlation, r_s=-0.64, df=23, P<0.05, Fig. 1). Larger spiders also had a shorter lag time between reaction to the prey and attack than smaller spiders (Spearman Rank Correlation, r_s=-0.64, df=23, P<0.05, Fig. 2). When the proportion of spider body size to prey body size was high, spiders exhibited a shorter lag time between reaction and attack than when the proportion was lower (Spearman Rank Correlation, r_s=-0.56, df=23, P<0.05, Fig. 3). All three correlations were statistically significant.

There was no significant difference in reaction time to live or dead prey (Kruskall-Wallis Test, KW=5.57, df=4, P=0.23). The lag time between reaction and attack was also not significantly different between dead prey and live prey (Kruskall-Wallis Test, KW=6.15, df=4, P=0.19).

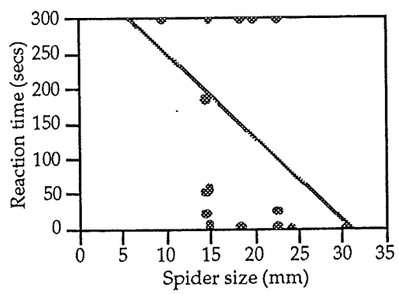

FIG.1. Time to reaction to presence of prey as a function of spider size.

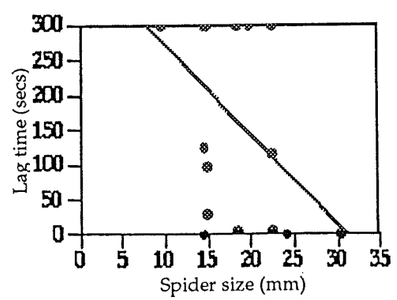

FIG. 2. Lag time between reaction to presence of prey and attack on prey as a function of spider size.

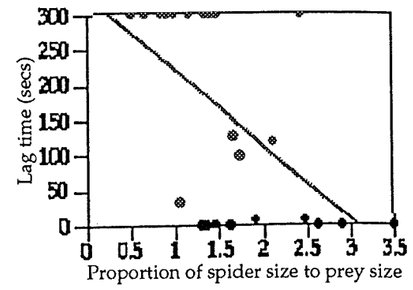

FIG. 3. Lag time between reaction to presence of prey and attack on prey as a function of proportion of spider size to prey size.

DISCUSSION (NDP)

Large spiders are indeed more successful predators in that they detect and capture prey faster than small spiders. Detection of possible prey within the orb is probably an innate response because it is vital to the survival of *N. clavipes*. However, our results suggest that learning does play a part in prey detection because larger spiders reacted faster when prey were put into their webs. Larger spiders, having encountered more prey in their lifetime, may be more sensitive to changes in the vibrations and tensions of their web and thus are able to react more quickly.

Large spiders capture prey faster than small spiders; it is possible this is also a function of more experience. Larger, older spiders have had more contact with prey over time. Such prior experience results in less hesitation by large spiders between detection time and actual contact time contributing to a greater success. This decreased hesitation may result in fewer valuable prey escaping from large spiders.

A prey that is proportionately much smaller than *N. clavipes* poses less of a threat to that spider than a prey of equal or greater size. Catching proportionately smaller prey is less of a risk than catching larger prey. Therefore spiders facing a

smaller prey should somehow sense the difference in size between themselves and their prey and, consequently, hesitate less before attacking it.

A reliable mechanism of prey detection and size assessment is crucial to a spider's survival. This allows the spider to weigh the costs of each attack, determining the degree of caution that should be taken to ensure a safe encounter without giving the prey time to escape. We believed that this mechanism of detection and assessment would be based on sensitivity to movement in the web. However, our data do not support this hypothesis, as spiders detected and attacked dead as well as live prey. Observations suggest that these spiders instead use a measure of tension on the web as an indicator of prey presence. After prey flew into the web, the golden orb-spiders would pull against the web with their front two legs. We believe that spiders, alerted to the presence of the prey by its initial strike against the web, were testing the tension of the strands to determine the weight and size of the entrapped item. This assessment of size and weight may be used to determine the amount of caution a spider should take in advancing towards prey.

We noticed that small spiders probably have become satiated after one or two trials within a single day, whereas, the largest spiders we studied repeatedly devoured any prey we gave them. Future studies concerning by *N. clavipes* should therefore determine the daily food requirement of different sizes of spiders.

The web size of our spiders varied greatly. It is possible that web size and size of the spider are associated with each other. It would be useful to quantify a correlation between spider and web size and determine if this has any additional affect on predatory success.

Although direct confrontations between *N. clavipes* and its prey could be dangerous to this predator, it appears that small spiders can be successful as long as they exhibit some caution before striking. Although they may not react quickly and appear to avoid larger prey, they are able to obtain enough energy to sustain themselves. With more experience, spiders can become more successful predators. The increased efficiency and success that comes with experience is necessary for larger spiders to maintain their high energy, aggressive capture strategies.

LITERATURE CITED

Lubin, Y. D. 1983. *Nephila clavipes* (Araña de Oro, Golden Orb-Spider). Pages 745-747 *in* D. H. Janzen, editor. *Costa Rican Natural History*. University of Chicago Press, Chicago, USA.